FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
220575US2PCT	10/089158

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP00/05152	31 July 2000	none

TITLE OF INVENTION

TRAFFIC CONTROL SYSTEM FOR MOBILE COMMUNICATIONS SYSTEM

APPLICANT(S) FOR DO/EO/US

KATAOKA Masayuki

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

PCT/IB/308
Form PTO-1449
Drawings (8 sheets)
Cited References (3) / Statement of Relevancy

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/089158	PCT/JP00/05152	220575US2PCT

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1040.00
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$890.00
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$740.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$710.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =				$890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	7 - 20 =	0	x $18.00	$0.00	
Independent claims	2 - 3 =	0	x $84.00	$0.00	
Multiple Dependent Claims **(check if applicable)**.			☐	$0.00	
TOTAL OF ABOVE CALCULATIONS =				$890.00	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				$0.00	
SUBTOTAL =				$890.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				$0.00	
TOTAL NATIONAL FEE =				$890.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				$0.00	
TOTAL FEES ENCLOSED =				$890.00	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Marvin J. Spivak
NAME

24,913
REGISTRATION NUMBER

March 27 2002
DATE

SPECIFICATION

TRAFFIC CONTROL SYSTEM FOR MOBILE COMMUNICATIONS SYSTEM

TECHNICAL FIELD

The present invention relates to a traffic control system for a mobile communications system having multilayer radio coverage.

BACKGROUND ART

(1) RELATED ART 1

In a mobile communications system, multilayer wireless coverage, using a plurality of base stations (BTS) and different cell sizes, is usually implemented. A micro cell has a very small coverage area and is used in an area where it is difficult to accommodate a large number of subscribers. A macro cell has a large coverage area and often includes geographical areas of more than one micro cells. In the multilayer radio coverage, a macro cell corresponds to a high-level coverage area and a micro cell corresponds to a low-level coverage area.

In the multilayer wireless coverage, a radio wave transmitted from a mobile station (MS) is simultaneously received by a plurality of BTSs to enable site diversity that deals with long-period variation in fading.

Published Japanese Translation of PCT

International Publication No. 11-509069 (referred to as related art 1) discloses a mobile communications system with multilayer radio coverage. The related art 1 discloses a method of monitoring a load derived from communication traffic in a macro cell by determining a ralative traveling speed of MSs in a micro cell. However, it does not describe site diversity.

In the related art 1, a service time for MSs in a micro cell is measured so as to determine a proportion N of the number of mobile stations served for a service time shorter than a preset threshold service time M. Those MSs in the micro cell belonging to the proportion N are handed over to a target macro cell, the hand-over being carried out in the decreasing order of relative traveling speed. By controlling the preset threshold service time M, it is ensured that a desired level of load derived from communications traffic occurs in a macro cell.

(2) Related art 2

Fig. 1 is a block diagram showing a construction of the pan-European GSM mobile communications system (referred to as related art 2).

A mobile station (MS) 3 is connected to a base station (BTS) 16a via a radio channel and is constantly measuring a signal from an adjacent BTS 16b for a possible handover. Generally, several base station controllers (BSC) 17, 19 operate under

the control of a mobile service switching center (MSC) 31. The MSC 31 is connected to another MSC and is connected to a public switched telephone network or an integrated services digital network via a gateway mobile service switching center (GMSC) 51.

The operation of the entirety of the mobile communications system is monitored by an operation and management center (OMC) 41. Subscriber data of a subscriber of the MS 3 is permanently stored in a home location register (HLR) 52 and temporarily stored in a visitor location register (VLR) 32 for an area in which the MS 3 is located. The VLR 32 used in the European GSM system stores subscriber data needed by the MSC 31 for connection control in a mobile network of a carrier. The data is created in the MSC 31 of an area to which the MS 3 traveled.

In a current mobile communications system, the VLR 32 is provided for each of a plurality of geographical areas. As the number of subscribers increase, the number of the VLRs 32 should be increased. For example, one VLR 32 is required for a subscriber population of hundred thousand. In a large city where there are several millions of subscribers, a total of 10-100 VLRs 32 are required.

The VLR 32 is often constructed as a database. It is proposed that a multilayer database be used for management of data items each having a plurality of attributes (dimensions). It is also proposed that a database related to the BSCs 17, 19

and the OMC 41 be constructed as a multilayer database.

In the mobile communications system of the related art 2 shown in Fig. 1, the subscriber data for the MS 3 of a given area is not necessarily available to the MSC 31 controlling the area. The MSC 31 loads the subscriber data from the MSC having that data when the MS 3 registers its location in the area controlled by the MSC 31.

(3) Related art 3

A multi-dimensional database is considered to be useful for communication traffic management. Fig. 2 is a block diagram showing a data load system (referred to as related art 3 and shipped since January 31, 1997) from Japan Oracle Corporation Japan, as an example of multidimensional database system.

Referring to Fig. 2, a database system 70 manages a database 71 and is provided with an aggregation process unit 72 for multi-dimensional aggregation of data. A multi-dimensional database system 90 performs multi-dimensional aggregation, based on multi-dimensional aggregation data generated by the aggregation process unit 72 of the database system 70. A multi-dimensional aggregation data management unit 92 updates the multi-dimensional aggregation database 91.

A database load system 80 is provided with an import process function unit 81 for loading the multi-dimensional aggregation data generated by the

multi-dimensional aggregation process unit 72 of the database system 70 into the multi-dimensional database 90.

Referring to Fig. 2, when data is added to the database 71 of the database system 70, the aggregation process unit 72 performs multi-dimensional aggregation process on difference data arising from the added data. The import process function unit 81 of the data load system 80 loads the difference multi-dimensional aggregation data generated by the aggregation process unit 72 into the multi-dimensional database system 90. The multi-dimensional aggregation data management unit 92 of the multi-dimensional database system 90 receiving the difference multi-dimensional aggregation data via the data load system 80 retrieves the multi-dimensional aggregation data from the multi-dimensional aggregation database 91 in order to ensure that the received data is properly reflected. The multi-dimensional aggregation data management unit 92 then performs multi-dimensional aggregation process, based on the received difference multi-dimensional so as to update the multi-dimensional aggregation database 91, based on the multi-dimensional aggregation data generated as a result of the multi-dimensional aggregation process.

(4) Related art 4

Open systems interconnection (OSI), prescribing communication between applications

running on respective computers, supports at Layer 7 (referred to as related art 4) remote database access and job transfer protocol.

When a multi-dimensional database is located in a network, a sequence of multi-dimensional aggregation process and data load may be requested using OSI Layer 7.

(5) Related art 5

Japanese Laid-Open Application No. 11-110268 (referred to as related art 5) discloses a data load system capable of data load into a multi-dimensional database system. This data load system is provided with a difference data multi-dimensional aggregation means for performing multi-dimensional aggregation of difference data arising from data added to a database, and a multi-dimensional aggregation data computing means for loading the difference multi-dimensional aggregation data generated by the difference data multi-dimensional aggregation means into a multi-dimensional database system and for adding data items constituting the difference multi-dimensional aggregation data to corresponding data items of multi-dimensional aggregation data retrieved from a multi-dimensional aggregation database, so as to update the multi-dimensional aggregation data.

In the related art 5, by performing a multi-dimensional aggregation process, normally performed in a multi-dimensional database system, as part of a difference data load process, the volume of

process required for a multi-dimensional aggregation process is reduced.

In a mobile communications system, there is a requirement for multi-dimensional aggregation process using a multi-dimensional database, for control of communications traffic over a large number of MSs 3. The multi-dimensional database system according to the related art 3, however, has a disadvantage in that, the import function provided in the data load system 80 is only directed to data load. In order to incorporate the difference data 201 in the multi-dimensional database 91, a multi-dimensional aggregation process should be performed separately after the load operation.

The multi-dimensional aggregation process according to the related art 3 proceeds such that data items stored in the multi-dimensional aggregation database 91 are added to the entirety of the difference data 201 to determine subtotals, and a grand total is obtained by adding the subtotals. Therefore, as the number of data items increase, a huge amount of time and load are required for a multi-dimensional aggregation process. For this reason, the multi-dimensional aggregation process according to the related art 3 is performed periodically. A disadvantage derived from this is that it is difficult to process multi-dimensional database real-time aggregation and data load sequentially as an event-driven real-time

process.

The related art 5 proposes to reduce the volume of process required for a multi-dimensional aggregation process, by performing a multi-dimensional aggregation process, normally performed in a multi-dimensional database system, as part of a difference data load process. The related art 5, however, is not adapted for a bidirectional database system providing for data feedback occurring, for example, in a mobile communication.

In a micro cell of the related art 1, it is difficult to control the quality of communication for the MS 3 traveling at a high relative speed. Moreover, it is difficult to accommodate a large number of subscribers so that there is a need to impose a restriction on the subscriber capacity.

The present invention has been developed with a view to resolving the aforementioned disadvantages and has an objective of providing a communication traffic control system for a mobile communications system, by using an event-driven data load means to perform a multi-dimensional aggregation process as part of a difference data load process so that a multi-dimensional aggregation process related to communication traffic in a network is performed as a real-time process and the volume of process required for the multi-dimensional aggregation process is reduced.

Another objective is to provide a communication traffic control system for a mobile

communications system capable of accommodating a maximum subscriber capacity in the micro cell 2 on which the subscriber capacity restriction is imposed.

Still another objective is to provide a communication traffic control system in which site diversity, control of communication quality for the MS 3 traveling at a high relative speed in the micro cell 2, blockage of a branch are performed on a real time basis, in which variation in communication quality for the MS 3 due to the travel is canceled, and in which a load derived from communication traffic is reduced.

DISCLOSURE OF THE INVENTION

The present invention provides a communication traffic control system for a mobile communications system, in which communication traffic occurring in a macro cell and a micro cell is controlled, comprising: a macro cell base station communicating with mobile stations in the macro cell having a relatively large coverage area; a macro cell base station controller managing the macro cell base station; a micro cell base station communicating with mobile stations in the micro cell having a relatively small coverage area in the macro cell; a micro cell base station controller managing the micro cell base station; a mobile service switching center providing circuit switching service for the macro cell base station controller and the micro

cell base station controller, wherein those mobile stations, communicating with the macro cell base station with a relatively poor communication quality and served for a service time shorter than a preset threshold service time, are subject to site diversity effected by the macro cell base station and the micro cell base station, by establishing communication between the macro cell base station, the macro cell base station controller, the mobile switching center, the micro cell base station controller and the micro cell base station.

Accordingly, communication quality is prevented from dropping, and circuit switching in accordance with communication quality is enabled so that communication traffic is properly controlled.

For those mobile stations, subject to site diversity and traveling in a micro cell at a relative traveling speed higher than a preset threshold relative traveling speed, a transmission power of the micro cell base station may be raised.

Accordingly, variation in communication quality for a mobile station traveling at a high relative traveling speed in a micro cell is canceled.

For those mobile stations, subject to site diversity and traveling at a relative traveling speed lower than a preset threshold relative traveling speed, a branch into the macro cell base station may be blocked.

Accordingly, a load derived from communication traffic and imposed on a macro cell BTS is reduced, and circuit switching in accordance with communication quality is enabled.

Site diversity by the macro cell base station and the micro cell base station may be resumed when the relative traveling speed of those mobile stations communicating only with the micro cell base station becomes higher than the preset threshold traveling speed.

Accordingly, variation in communication quality is canceled.

The communication traffic control system may further comprise: an operation and management center provided for operation and management of circuits covered by the mobile switching center, and storing the preset threshold service time and the preset threshold relative traveling speed, wherein the macro cell base station controller comprises: an aggregation process unit generating compressed difference data by item-by-item computation of a difference between each data item of user environment data, obtained by measurement by the macro cell base station and the mobile station, and associated reference levels, and performing a multi-dimensional aggregation process on the compressed difference data thus generated so as to compute difference multi-dimensional aggregation data, the difference multi-dimensional aggregation data being transferred to the operation

and management center via the macro cell base station controller and the mobile switching center, and wherein the operation and management center comprises: a multi-dimensional aggregation data management unit updating the currently stored preset threshold service time and preset threshold relative traveling speed, based on the transferred multi-dimensional aggregation data, so as to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell, the updated preset threshold service time and preset threshold relative traveling speed being transferred to the macro cell base station controller, the macro cell base station, the micro cell base station controller and the micro cell base station.

Accordingly, it is ensured that a minimum bandwidth is allocated to all mobile stations in a macro cell, and a maximum subscriber capacity is accommodated in a micro cell on which a restriction on subscriber capacity is imposed.

The communication traffic control system may further comprise data load means comprising: an automatic difference data multi-dimensional aggregation statement generation and execution unit operating such that, when the aggregation process unit receives the user environment data, the automatic difference data multi-dimensional aggregation statement generation and execution unit automatically generates and executes a statement that causes communication to be established between

the macro cell base station and the operation and management center via the mobile switching center, causes the aggregation process unit to generate the compressed difference data, based on the user environment data, and to compute difference multi-dimensional aggregation data by performing a multi-dimensional aggregation process on the compressed difference data thus generated; a unit for automatic generation and execution of a data load program with an addition instruction operating such that, when the difference multi-dimensional aggregation data is computed, the unit automatically generates a data load program with an addition instruction, creating a statement for loading the difference multi-dimensional aggregation data from the aggregation process unit into the multi-dimensional aggregation data management unit of the operation and management center, and causing the multi-dimensional aggregation data management unit to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell by updating the preset threshold service time and the preset threshold relative traveling speed, based on the transferred difference multi-dimensional aggregation data; and an automatic reverse data load program generation and execution unit operating such that, when the preset threshold service time and the preset threshold relative traveling speed are updated, the automatic reverse data load program generation and

execution unit automatically generates a statement for loading the updated preset threshold service time and preset threshold relative traveling speed from the multi-dimensional aggregation data management unit into the macro cell base station controller and the micro cell base station controller via the mobile switching center.

Accordingly, a preset threshold service time and a preset threshold relative traveling speed are updated on a real-time basis so that the volume of process is reduced.

The present invention also provides a communication traffic control system for a mobile communications system in which communication traffic occurring in a macro cell and a micro cell is controlled, comprising: a macro cell base station communicating with mobile stations in the macro cell having a relatively large coverage area; a macro cell base station controller managing the macro cell base station; a micro cell base station communicating with mobile stations in the micro cell having a relatively small coverage area in the macro cell; a micro cell base station controller managing the micro cell base station; a mobile service switching center providing circuit switching service for the macro cell base station controller and the micro cell base station controller; and an operation and management center provided for operation and management of circuits covered by the mobile switching center, and storing

a preset threshold service time and a preset threshold relative traveling speed related to communication traffic, wherein the macro cell base station controller comprises: an aggregation process unit generating compressed difference data by item-by-item computation of a difference between each data item of user environment data, obtained by measurement by the macro cell base station and the mobile station, and associated reference levels, and performing a multi-dimensional aggregation process on the compressed difference data thus generated so as to compute difference multi-dimensional aggregation data, the difference multi-dimensional aggregation data being transferred to the operation and management center via the macro cell base station controller and the mobile switching center, and wherein the operation and management center comprises: a multi-dimensional aggregation data management unit updating the currently stored preset threshold service time and preset threshold relative traveling speed, based on the transferred multi-dimensional aggregation data, so as to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell, the updated preset threshold service time and preset threshold relative traveling speed being transferred to the macro cell base station controller, the macro cell base station, the micro cell base station controller and the micro cell base station, the communication traffic control

system further comprises data load means comprising: an automatic difference data multi-dimensional aggregation statement generation and execution unit operating such that, when the aggregation process unit receives the user environment data, the automatic difference data multi-dimensional aggregation statement generation and execution unit automatically generates and executes a statement that causes communication to be established between the macro cell base station and the operation and management center via the mobile switching center, causes the aggregation process unit to generate the compressed difference data, based on the user environment data, and to compute difference multi-dimensional aggregation data by performing a multi-dimensional aggregation process on the compressed difference data thus generated; a unit for automatic generation and execution of a data load program with an addition instruction operating such that, when the difference multi-dimensional aggregation data is computed, the unit automatically generates a data load program with an addition instruction, creating a statement for loading the difference multi-dimensional aggregation data from the aggregation process unit into the multi-dimensional aggregation data management unit of the operation and management center, and causing the multi-dimensional aggregation data management unit to ensure that a minimum bandwidth is allocated to all

the mobile stations in the macro cell by updating the preset threshold service time and the preset threshold relative traveling speed, based on the transferred difference multi-dimensional aggregation data; and an automatic reverse data load program generation and execution unit operating such that, when the preset threshold service time and the preset threshold relative traveling speed are updated, the automatic reverse data load program generation and execution unit automatically generates a statement for loading the updated preset threshold service time and preset threshold relative traveling speed from the multi-dimensional aggregation data management unit into the macro cell base station controller and the micro cell base station controller via the mobile switching center, and wherein communication traffic is controlled based on the updated preset threshold service time and preset threshold relative traveling speed loaded by the data load means.

Accordingly, a preset threshold service time and a preset threshold relative traveling speed are updated on a real-time basis so that the volume of process is reduced. Moreover, it is ensured that a minimum bandwidth is allocated to all mobile stations in a macro cell, and a maximum subscriber capacity is accommodated in a micro cell on which a restriction on subscriber capacity is imposed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a construction of the pan-European GSM mobile communications system according to the related art 2.

Fig. 2 is a block diagram showing a construction of a data load system according to the related art 3.

Fig. 3 is a schematic diagram showing a construction of a mobile communication system according to a first embodiment of the present invention.

Fig. 4 is a block diagram showing a construction of a communication traffic control system for a mobile communications system according to the first embodiment.

Fig. 5 is a flowchart showing an overall flow of processes of the communication traffic control system according to the first embodiment.

Fig. 6 is a flowchart showing a user environment data process according to the first embodiment.

Fig. 7 is a flowchart showing a process for connection to a micro cell BTS according to the first embodiment.

Fig. 8 shows how site diversity and transmission power control are performed according to the first embodiment.

Fig. 9 is a flowchart showing a communication traffic data process according to the first embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

In order to describe finer details of the present invention, the best mode for carrying out the invention will be described with reference to the attached drawings.

First embodiment

Fig. 3 is a schematic view showing a construction of a mobile communications system according to a first embodiment of the present invention. Referring to Fig. 3, the system comprises a macro cell 1 having a large coverage area, a micro cell 2 having a small coverage area, and a mobile station (MS) traveling in the macro cell 1 or the micro cell 2.

The system further comprises a macro cell base station (BTS) 11 communicating with the MS 3 in the macro cell 1, a macro cell base station controller (BSC) 12 for managing the macro cell BTS 11, a multi-dimensional database 13 provided in the macro cell BSC 12 and storing data related to the MS 3 in the macro cell 1, a micro cell BTS 21 communicating with the MS 3 in the micro cell 2, a micro cell BSC 22 managing the micro cell BTS 21, and a multi-dimensional database 23 provided in the micro cell BSC 22 and storing data related to the MS 3 in the micro cell 2.

The system further comprises a mobile switching center (MSC) 31 providing circuit switching service for the macro cell BSC 21 and the micro cell BSC 22, a visitor location register 32

storing subscriber data, an operation and management center (OMC) 41 for operation and management of circuits covered by the MSC 31, a multi-dimensional database 42 storing information related to the circuits, a gateway mobile service switching center (GMSC) 51 managing circuit switching service involving a PSTN and an ISDN, and a home location register (HLR) 52 storing subscriber data.

Fig. 4 is a block diagram showing a construction of a communication traffic control system for a mobile communication system according to the first embodiment. In Figs. 3 and 4, like numerals represent like elements. Numeral 101 represents user environment data. The user environment data is obtained by measurement performed by the macro cell BTS 11 and the MS 3 when the MS 3 accesses the macro cell BTS 11 to start a communication session or when the MS 3 communicating with the macro cell BTS 1 moves to the micro cell 2. Alternatively, the measurement may be performed periodically. The user environment data includes a mobile station code, service time, relative location, relative traveling speed, communication quality, transmission speed, transmission power of each of the MSs 3 communicating with the macro cell BTS 11. It also includes a base station code of the macro cell BTS 11 and a base station code of a nearby micro cell BTS 21.

Numeral 102 indicates compressed difference data obtained by item-by-item computation of a difference of each of the service time, relative traveling speed, communication quality, transmission speed, transmission power from the respective reference levels. The compressed difference data also includes a mobile station code of the MS 3, a base station code of the macro cell BTS 11, a base station code of the nearby micro cell BTS 21. By definition, compression refers to elimination of elements of degrees unnecessary for an aggregation process from the user environment data 101 stored in the multi-dimensional database 13.

An aggregation process unit 14 provided in the macro cell BSC 12 generates the compressed difference data 102 from the user environment data 101 stored in the multi-dimensional database 13, stores the compressed difference data 102 in the multi-dimensional database 13, and retrieves the compressed difference data 102 stored in the multi-dimensional database 13 to perform a multi-dimensional aggregation process and output difference multi-dimensional aggregation data 103.

The aggregation process unit 14 also selects MSs 3 subject to site diversity from those MSs 3 suffering relatively low communication quality. Of those MS 3 subject to site diversity, MSs 3 with a relative traveling speed exceeding a preset threshold relative traveling speed V are selected

by the aggregation process unit 14 as a target for transmission power control. A mobile station transmission power control start/end code 104 is transmitted by the aggregation process unit 14 to an aggregation process unit 24 of the micro cell BSC 22 via the MSC 31.

Of those MS 3 subject to site diversity, MSs 3 with a relative traveling speed below a preset threshold relative traveling speed V are selected by the aggregation process unit 14 as a target for branch blockage. The aggregation process unit 14 stores a mobile station branch blockage code 105 in the multi-dimensional database 13 and transmits the code to the macro cell BTS 11.

Moreover, the aggregation process unit 14 stores a mobile station site diversity resumption code 108 (described later), an update preset threshold service time T and an update preset threshold relative traveling speed V 112 in the multi-dimensional database 13 and transmits the code 108, the time T and the speed V 112 to the macro cell BTS 11.

Numeral 106 indicates user environment data obtained by measurement by the micro cell BTS 21 and the MS 3. Like the user environment data 101, the user environment data 106 includes a mobile station code, service time, relative location, relative traveling speed, communication quality, transmission speed, transmission power of each of the MSs 3 communicating with the micro cell BTS 21.

The user environment data 106 also includes a base station code of the micro cell BTS 11 and a base station code of the nearby micro cell BTS 21.

Numeral 107 indicates compressed difference data that includes a mobile station code of the MS 3, a base station code of the micro cell BTS 21, a base station code of the nearby macro cell BTS 11. The compressed difference data is obtained by computing a difference of each of the service time, relative traveling speed, communication quality, transmission speed, transmission power with respect to the respective reference levels. By definition, compression refers to elimination of elements of degrees unnecessary for an aggregation process from the user environment data 106 stored in the multi-dimensional database 23.

An aggregation process unit 24 provided in the micro cell BSC 22 transmits the mobile station transmission power control start/end code 104 from the aggregation process unit 14 of the macro cell BSC 22 to the micro cell BTS 21, generates the compressed difference data 107 from the user environment data 106 stored in the multi-dimensional database 23, stores the compressed difference data 107 in the multi-dimensional database 23, retrieves the compressed difference data 107 stored in the multi-dimensional database 23 to perform a multi-dimensional aggregation process and output the mobile station site diversity resumption code 108.

The aggregation process unit 24 also stores the updated preset threshold service time T and the present threshold relative traveling speed V 112 in the multi-dimensional database 23 and transmits the time T and the speed V 112 to the micro cell BTS 21.

The difference multi-dimensional aggregation data 103 output from the aggregation process unit 14 of the macro cell BSC 12 includes, in addition to the compressed difference data 102, mobile station codes in which the MSs 3 are graded in the increasing order or communication quality, mobile station codes in which the MSs 3 are graded in the decreasing order of relative traveling speed, and the number of mobile stations R served for a service time shorter than the preset threshold service time T.

Numeral 43 indicates a multi-dimensional aggregation data management unit 43 provided in the OMC 41. The multi-dimensional aggregation data management unit 43 retrieves multi-dimensional aggregation data 111 related to communication traffic and stored in a multi-dimensional database 42, the multi-dimensional aggregation data 111 including the communication capacity, preset threshold service time T and preset threshold relative traveling speed V. The multi-dimensional aggregation data management unit 43 performs a multi-dimensional aggregation process by adding, item by item, to the multi-dimensional aggregation data 111 the compressed difference data 102

contained in the difference multi-dimensional aggregation data 103 transmitted from the aggregation process unit 14 of the macro cell BSC 12. The multi-dimensional aggregation data management unit 43 also updates the preset threshold service time T and the preset threshold relative traveling speed V of the macro cell BSC 12 so as to ensure that a minimum bandwidth is allocated to all the MSs 3 in the macro cell 1, and stores the updated time T and the speed V in the multi-dimensional database 42. The updated preset threshold service time T and the preset threshold relative traveling speed V 112 are output to the MSC 13 from the multi-dimensional aggregation data management unit 43.

By ensuring that a minimum bandwidth is allocated to all the MSs 3 in the macro cell 1 by updating the preset threshold service time T and the preset threshold relative traveling speed V, it is ensured that the subscriber capacity of the micro cell 2, to which the subscriber capacity is imposed, is enlarged.

The preset threshold service time T is preset for the macro cell 1 and indicates a communication service time allocated to the MS 3 and providing a reference to determine the start and end of site diversity. The preset threshold relative traveling speed V is preset for the macro cell 1 and indicates a relative traveling speed of the MS 3 providing a reference to determine connection and

blockage of a branch and transmission power control.

Numeral 60 indicates an event-driven data load means for bidirectional data load between the macro cell BSC 12 and the OMC 41, and between the OMC 41, the macro cell BSC 12 and the micro cell BSC 22. The event-driven data load means 60 comprises an automatic difference data multi-dimensional aggregation statement generation and execution unit 61, a unit 62 for automatic generation and execution of a data load program with an addition instruction, and an automatic reverse data load program generation and execution unit 63.

When the macro cell 12 receives the user environment data 101, the automatic difference data multi-dimensional aggregation statement generation and execution unit 61 automatically generates a multi-dimensional aggregation statement that creates three jobs. A first job calls for connection for communication established between the macro cell BSC 12 and the OMC 41 via the MSC 31. A second job calls for generation of the compressed difference data 102 based on the user environment data 101 in the aggregation process unit 14. A third job calls for conversion of the difference multi-dimensional aggregation data 103, output from the aggregation process unit 14 as a result of the multi-dimensional aggregation process, into a communication data format. The automatic difference data multi-dimensional aggregation statement generation and execution unit 61 transfers the jobs

to the aggregation process unit 14 for execution of the statement in the aggregation process unit 14.

When the difference multi-dimensional aggregation data 103 is computed, the unit 62 automatically generates a data load program with an addition instruction. A resultant statement creates three jobs. A first job calls for load of the difference multi-dimensional aggregation data 103 from the aggregation process unit 14 into the multi-dimensional aggregation data management unit 43 of the OMC 41. A second job calls for conversion of the difference multi-dimensional aggregation data 103 thus loaded into a data format adapted for the multi-dimensional database 42. A third job calls for a multi-dimensional aggregation process of the difference multi-dimensional aggregation data 103 in the multi-dimensional aggregation data management unit 43, thereby ensuring that a minimum bandwidth is allocated to all the MS 3 in the macro cell 1 by updating the preset threshold service time T and the preset threshold relative traveling speed V. The created jobs are transferred from the unit 62 to the multi-dimensional aggregation data management unit 43 for execution of the statement in the aggregation process unit 14.

When the multi-dimensional database 42 is updated, the automatic reverse data load program generation and execution unit 63 automatically generates a data load program. A resultant statement creates a job that calls for conversion

of the updated preset threshold service time T and the preset threshold relative traveling speed V 112 into the communication data format, and loading of the time T and the speed V 112 into the aggregation process unit 14 of the macro cell BSC 12 and the aggregation process unit 24 the entirety of micro cells BSC 22, from the multi-dimensional aggregation data management unit 43 and via the MSC 31. The automatic reverse data load program generation and execution unit 63 transfers the created jobs to the multi-dimensional aggregation data management 43 and the MSC 31 for execution.

A description will now be given of the operation according to the first embodiment.

Fig. 5 is a flowchart showing an overall flow of processes in the communication traffic control system for a mobile communications system according to the first embodiment. In step ST1, the MS 3 connects to the macro cell BTS 11 to start communication. This connection occurs when the MS 3 accesses the macro cell BTS 11 or when the MS 3 is located in the micro cell 2.

In step ST2, the MS 3 and the macro cell BTS 11 obtains the user environment data 101 by measurement and the macro cell BSC 12 processes the user environment data 101. Measurement for obtaining the user environment data 101 may alternatively be conducted periodically. A detailed description of how the user environment data 101 is processed will be given later.

In step ST3, a determination is made in step ST 3 as to whether the MS 3 in the macro cell 1 is also located in the micro cell 2. If an affirmative answer is yielded, the MS 3 connects to the micro cell BTS 21 for the micro cell 2 in step ST4. Step ST4 is omitted for the MS 3 not located in the micro cell 2. The process for connection to the micro cell BTS 21 will be detailed later.

In step ST5, the user environment data 101 is obtained by measurement in the micro cell 2. A data process related to communication traffic in all MSs 3 in the macro cell 1 is performed, based on the user environment data 101 obtained in step ST5. The preset threshold service time T and the preset threshold relative traveling speed V are updated so as to ensure that a minimum bandwidth is allocated to all MSs 3. Control is then returned to step ST2 to repeat the subsequent steps. By repeating these steps, real-time communication traffic control is effected in response to the traveling of the MS 3 in the macro cell 1. Details of the communication traffic data process in ST5 will be given later.

Fig. 6 is a flowchart showing a user environment data process in step ST2 of Fig. 5. In step ST21, the macro cell BTS 11 and the MS 3 obtained the user environment data 101 of the MS 3 in the macro cell 1. In step ST22, the user environment data 101 is transmitted from the macro cell BTS 11 to the macro cell BSC 12, stored in the multi-dimensional database 13 and transmitted to

the aggregation process unit 14. In step ST23, when the aggregation process unit 14 receives the user environment data 101, the automatic difference data multi-dimensional aggregation statement generation and execution unit 61 of the data load means 60 automatically generates a multi-dimensional aggregation statement that creates a job calling for connection for communication established between the macro cell BSC 12 and the OMC 41 via the MSC 31, and a job calling for generation of the compressed difference data 102 based on the user environment data 101 in the aggregation process unit 14. These jobs are transferred to the aggregation process unit 14 for execution of the statement in the aggregation process unit 14.

Fig. 7 is a flowchart showing the process in step ST4 of Fig. 5 for connection to the micro cell BTS 21. In step ST41, the automatic difference data multi-dimensional aggregation statement generation and execution unit 61 of the data load means 60 uses the aggregation process unit 14 to grade the MSs 3, located in the micro cell 2 and provided with respective mobile station codes, in the increasing order of communication quality.

In step ST42, the aggregation process unit 14 performs multi-dimensional aggregation on the compressed difference data 102 so as to determine the number R of mobile stations subject to site diversity. Site diversity is performed by the macro cell BTS 11 and the micro cell BTS 21 for a total

of R MSs 3 suffering the poorest communication quality in the micro cell 2, based on the control by the macro cell BSC 12 and the micro cell BSC 22. The number R of mobile stations subject to site diversity is defined as the number of mobile stations (MS) 3 served for a service time shorter than the preset threshold service time T, located in one of the micro cells 2 in the macro cell 1, and communicating with the macro cell BTS 11. In the case of communication with an extended service time, and, more particularly, in the case of data communication, invalidate circuit connection occupies a major portion of the service time so that site diversity does not produce much effect. Therefore, site diversity is applied to those MSs 3 served for a short service time and expected to gain much benefit from site diversity.

In step ST43, the aggregation process unit 14 grades a total of R MSs 3 in the increasing order of communication quality so as to determine the sequence of site diversity process. In step ST44, the macro cell BTS 11 communicates with the micro cell BTS 21 via the macro cell BSC 12, the MSC 31 and the micro cell BSC 22. The MSC 31 performs circuit switching so that the macro cell BTS 11 and the micro cell BTS 21 perform site diversity for the target MSs 3. Fig. 8 shows how site diversity and the transmission power control (described later) are performed. "a" in Fig. 8 indicates site diversity.

In step ST45, the aggregation process unit 14 selects those MSs 3 subject to site diversity traveling at a relative traveling speed higher than the preset threshold relative traveling speed V. The aggregation process unit 14 identifies a mobile station transmission power control start/end code 104 for controlling those MSs 3 traveling at a high relative traveling speed to raise the transmission power so as to cancel a variation in communication quality, and controlling those MSs 3 traveling at a low relative traveling speed to maintain the current transmission power. In step ST46, the aggregation process unit 14 transfers the mobile station transmission power control start/end 104 to the micro cell BTS 21 via the MSC 31 and the aggregation process unit 24 of the micro cell BSC 22. In accordance with the mobile station transmission power control start/end code 104 thus transferred, the micro cell BTS 21 controls the power of transmission from the micro cell BTS 21 to those MSs 3 traveling at a high relative traveling speed. The micro cell BTS 21 also controls the MSs 3 traveling at a high relative traveling speed to raise the transmission power and controls the MSs traveling at a low relative traveling speed to maintain the transmission power ("b" of Fig. 8).

In step ST45, the aggregation process unit 14 selects those MSs 3 subject to site diversity traveling at a relative traveling speed lower than the preset threshold relative traveling speed. In

step ST47, the aggregation process unit 14 identifies a mobile station branch blockage code 105 so as reduce a load imposed on the macro cell BTS 11. The aggregation process unit 14 transfers the mobile station branch blockage code 105 to the macro cell BTS 11 so as to block a branch into the macro cell BTS 11 ("c" of Fig. 8).

Steps ST45 through ST47 will be summarized as follows. More specifically, in consideration of the fact that those MSs 3, subject to site diversity and having greater chances of passing through the micro cell 2 as a result of traveling at a relative traveling speed higher than the preset threshold relative traveling speed, undergoes a rapidly changing fading condition, the transmission power is controlled so as to cancel variation in communication quality. For those MSs 3 unlikely to pass through the micro cell 2 as a result of traveling at a low relative traveling speed and not undergoing a relatively constant fading condition, the branch into the macro cell BTS 11 is blocked so that the load derived from communication traffic and imposed on the macro cell BTS 11 is reduced.

When the MS 3 communicating only with the micro cell BTS 21 as a result of the step ST47 begins to travel at a relative traveling speed higher than the preset threshold relative traveling speed V, there are chances that the MS 3 escapes from the micro cell 2. To deal with this, the micro cell BTS 21 and the MS 3 in the micro cell 2

determine in step ST48 the user environment data 106 by measurement. The micro cell BTS 21 transfers the user measurement data 106 to the aggregation process unit 24 of the micro cell BSC 22.

In step ST49, the aggregation process unit 24 generates the compressed difference data 107, based on the user environment data 106, and performs a multi-dimensional aggregation process on the compressed difference data 107. The aggregation process unit 24 selects those MSs 3 determined to be traveling at a relative traveling speed higher than the preset threshold relative traveling speed V as targets for resumption of site diversity by the micro cell BTS 21 and the macro cell BTS 11. A mobile station site diversity resumption code 108 is then sent from the aggregation process unit 24 to the aggregation process unit 14 of the macro cell BSC 12.

In step ST50, the aggregation process unit 14 transfers the mobile station site diversity code 108 to the macro cell BTS 11. The macro cell BTS 11 and the micro cell BTS 21 resumes site diversity for the target MSs 3 ("d" of Fig. 8).

As described, those MSs 3 communicating only with the micro cell BTS 21 and traveling at a relative traveling speed higher than the preset threshold relative traveling speed V has chances of escaping the micro cell 2. In this case, variation in communication quality is canceled by resuming site diversity.

Fig. 9 is a flowchart showing a communication traffic data process performed in step ST5 of Fig. 5. In step ST51, the macro cell BTS 11 and the MS 3 in the macro cell 1 obtains the user environment data 101 of the MS 3 by measurement. In step ST52, the user environment data 101 is transferred from the macro cell BTS 11 to the multi-dimensional database 13 of the macro cell BSC 12 and further transferred to the aggregation process unit 14.

In step ST53, when the aggregation process unit 14 receives the user environment data 101, the automatic difference data multi-dimensional aggregation statement generation and execution unit 61 of the data load means 60 causes the aggregation process unit 14 to connect to the OMC 41 via the macro cell BSC 12 and the MSC 31. The automatic difference data multi-dimensional aggregation statement generation and execution unit 61 also causes the aggregation process unit 14 to generate the compressed difference data 102 based on the user environment data 101.

In step ST54, the automatic difference data multi-dimensional aggregation statement generation and execution unit 61 causes the aggregation process unit 14 to perform a multi-dimensional aggregation process on the compressed difference data 102 so as to compute the difference multi-dimensional aggregation data 103, and converts the difference multi-dimensional aggregation data 103 into the communication data format.

In step ST55, when the difference multi-dimensional aggregation data 103 is computed from the user environment data 101 related to all the MSs 3 in the macro cell 1, the unit 62 of the data load means 60 for automatic generation and execution of a data load program with an addition instruction automatically generates a data load program with an addition instruction. Further, the unit 62 loads the difference multi-dimensional aggregation data 103 thus loaded into the multi-dimensional aggregation data management unit 43 of the OMC 41, and converts the loaded difference multi-dimensional aggregation data 103 into a data format adapted for the multi-dimensional database 42.

In step ST56, the unit 62 of the data load means 60 causes the multi-dimensional aggregation data management unit 43 to add the compressed difference data 102 contained in the loaded difference multi-dimensional aggregation data 103 to the multi-dimensional aggregation data 11 stored in the multi-dimensional database 42. Moreover, the unit 62 updates the preset threshold service time T and the preset threshold relative traveling speed V so as to ensure that a minimum bandwidth is allocated to all the MSs 3 in the macro cell 1. An area evaluation experiment is used to determine how the preset threshold service time T and the preset threshold relative traveling speed V are updated in accordance with the number of MSs 3 and the result

of aggregation.

In step ST57, the automatic reverse data load program generation and execution unit 63 of the data load means 60 causes the updated preset threshold service time T and preset threshold relative traveling speed V 112 to be loaded from the multi-dimensional data management unit 43 into the MSC 31. The unit 63 also causes the time T and the speed V 112 to be loaded from the MSC 31 into the aggregation process unit 14 of the macro cell BSC 12 and the aggregation process unit 24 of all macro cell BSCs 22. If possible, the updated preset threshold service time T and preset threshold relative traveling speed V 112 are multicast.

In step ST58, the aggregation process unit 14 of the macro cell BSC 12 transfers the updated preset threshold service time T and the preset threshold relative traveling speed V 112 to the macro cell BTS 11. The aggregation process unit 24 of the micro cell BSC 22 transfers the updated time T and speed V 112 to all micro cell BTSs 21. The macro cell BTS 11 in the macro cell 1, the macro cell BSC 12, all micro cell BTSs 21, and all micro cell BSCs 22 replaces the currently stored preset threshold service time T and preset threshold relative traveling speed V by the updated preset threshold service time T and preset threshold relative traveling speed V 112. The updated preset threshold service time T and preset threshold relative traveling speed V 112 are referred to in

steps ST42, ST45 and ST49 of Fig. 7.

Thus, according to the first embodiment, by performing steps ST41-ST44 of Fig. 7, those MSs 3 communicating with the macro cell BTS 11 with a high communication quality are maintained in communication with the macro cell BTS 11. Those MSs 3 with a low communication quality are subject to site diversity by the macro cell BTS 11 and the micro cell BTS 21 so that the communication quality is prevented from dropping. Thus, circuit switching in accordance with communication quality is enabled so that communication traffic is controlled.

In further accordance with the first embodiment, by performing steps ST45-ST46 of Fig. 7, those MSs 3 subject to site diversity traveling at a high relative traveling speed and likely to suffer variation in communication quality are subject to transmission power control for increasing the transmission power. With this, variation in communication quality for those MSs 3 traveling at a high relative traveling speed in a micro cell is canceled.

In still further accordance with the first embodiment, by performing steps ST45-47 of Fig. 7, for those MSs 3 subject to site diversity traveling at a low relative traveling speed and unlikely to suffer variation in communication quality are processed, a branch into the macro cell BTS 11 is blocked. By allowing these MSs 3 to communicate only with the micro cell BTS 21, the load derived

from communication traffic and imposed on the macro cell BTS 11 is reduced, thus enabling circuit switching consistent with variation in communication quality.

In still further accordance with the first embodiment, by performing steps ST48-50 of Fig. 7, for those MSs 3 having a branch therefrom into the macro cell BTS 11 blocked and traveling at a high relative traveling speed, site diversity is resumed so that variation in communication quality is canceled.

In yet further accordance with the first embodiment, by performing steps ST51-ST58 of Fig. 8, the bidirectional event-driven data load means 60 is allowed to sequentially perform the multi-dimensional aggregation process for ensuring that a minimum bandwidth is allocated to all MSs 3 in the macro cell 1, i.e. the process of updating the preset threshold service time T and the preset threshold relative traveling speed V. Advantages from this are that real-time processing is enabled, the volume of process required for a multi-dimensional aggregation process is reduced, a minimum bandwidth is allocated to all MSs in a macro cell, and a maximum subscriber capacity is accommodate in a micro cell on which the subscriber restriction is imposed.

INDUSTRIAL APPLICABILITY

As described, the communication traffic

control system for a mobile communications system according to the present invention is adapted for real-time updating process of the preset threshold service time T and the preset threshold relative traveling speed V to ensure that a minimum bandwidth is allocated to all MSs 3 in the macro cell 1.

CLAIMS:

1. A communication traffic control system for a mobile communications system, in which communication traffic occurring in a macro cell and a micro cell is controlled, comprising:

a macro cell base station communicating with mobile stations in the macro cell having a relatively large coverage area;

a macro cell base station controller managing said macro cell base station;

a micro cell base station communicating with mobile stations in the micro cell having a relatively small coverage area in the macro cell;

a micro cell base station controller managing said micro cell base station;

a mobile service switching center providing circuit switching service for said macro cell base station controller and said micro cell base station controller, wherein

those mobile stations, communicating with said macro cell base station with a relatively poor communication quality and served for a service time shorter than a preset threshold service time, are subject to site diversity effected by said macro cell base station and said micro cell base station, by establishing communication between said macro cell base station, said macro cell base station controller, said mobile switching center, said micro cell base station controller and said micro

cell base station.

2. The communication traffic control system according to claim 1, wherein for those mobile stations, subject to site diversity and traveling in a micro cell at a relative traveling speed higher than a preset threshold relative traveling speed, a transmission power of said micro cell base station is raised.

3. The communication traffic system according to claim 1, wherein for those mobile stations, subject to site diversity and traveling at a relative traveling speed lower than a preset threshold relative traveling speed, a branch into said macro cell base station is blocked.

4. The communication traffic control system according to claim 3, wherein site diversity by said macro cell base station and said micro cell base station is resumed when the relative traveling speed of those mobile stations communicating only with said micro cell base station becomes higher than the preset threshold traveling speed.

5. The communication traffic control system according to claim 2 further comprising:

an operation and management center provided for operation and management of circuits covered by said mobile switching center, and storing the

preset threshold service time and the preset threshold relative traveling speed,

wherein said macro cell base station controller comprises:

an aggregation process unit generating compressed difference data by item-by-item computation of a difference between each data item of user environment data, obtained by measurement by said macro cell base station and said mobile station, and associated reference levels, and performing a multi-dimensional aggregation process on the compressed difference data thus generated so as to compute difference multi-dimensional aggregation data, the difference multi-dimensional aggregation data being transferred to said operation and management center via said macro cell base station controller and said mobile switching center,

and wherein said operation and management center comprises:

a multi-dimensional aggregation data management unit updating the currently stored preset threshold service time and preset threshold relative traveling speed, based on the transferred multi-dimensional aggregation data, so as to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell, the updated preset threshold service time and preset threshold relative traveling speed being transferred to said macro cell base station controller, said macro cell

base station, said micro cell base station controller and said micro cell base station.

6. The communication traffic control system according to claim 5, further comprising data load means comprising:

an automatic difference data multi-dimensional aggregation statement generation and execution unit operating such that, when said aggregation process unit receives the user environment data, said automatic difference data multi-dimensional aggregation statement generation and execution unit automatically generates and executes a statement that causes communication to be established between said macro cell base station and said operation and management center via said mobile switching center, causes said aggregation process unit to generate the compressed difference data, based on the user environment data, and to compute difference multi-dimensional aggregation data by performing a multi-dimensional aggregation process on the compressed difference data thus generated;

a unit for automatic generation and execution of a data load program with an addition instruction operating such that, when the difference multi-dimensional aggregation data is computed, the unit automatically generates a data load program with an addition instruction, creating a statement for loading the difference multi-dimensional aggregation data from said aggregation process unit

into said multi-dimensional aggregation data management unit of the operation and management center, and causing said multi-dimensional aggregation data management unit to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell by updating the preset threshold service time and the preset threshold relative traveling speed, based on the transferred difference multi-dimensional aggregation data; and

an automatic reverse data load program generation and execution unit operating such that, when the preset threshold service time and the preset threshold relative traveling speed are updated, the automatic reverse data load program generation and execution unit automatically generates a statement for loading the updated preset threshold service time and preset threshold relative traveling speed from said multi-dimensional aggregation data management unit into said macro cell base station controller and said micro cell base station controller via said mobile switching center.

7. A communication traffic control system for a mobile communications system in which communication traffic occurring in a macro cell and a micro cell is controlled, comprising:

a macro cell base station communicating with mobile stations in the macro cell having a relatively large coverage area;

a macro cell base station controller managing said macro cell base station;

a micro cell base station communicating with mobile stations in the micro cell having a relatively small coverage area in the macro cell;

a micro cell base station controller managing said micro cell base station;

a mobile service switching center providing circuit switching service for said macro cell base station controller and said micro cell base station controller; and

an operation and management center provided for operation and management of circuits covered by said mobile switching center, and storing a preset threshold service time and a preset threshold relative traveling speed related to communication traffic,

wherein said macro cell base station controller comprises:

an aggregation process unit generating compressed difference data by item-by-item computation of a difference between each data item of user environment data, obtained by measurement by said macro cell base station and said mobile station, and associated reference levels, and performing a multi-dimensional aggregation process on the compressed difference data thus generated so as to compute difference multi-dimensional aggregation data, the difference multi-dimensional aggregation data being transferred to said

operation and management center via said macro cell base station controller and said mobile switching center,

and wherein said operation and management center comprises:

a multi-dimensional aggregation data management unit updating the currently stored preset threshold service time and preset threshold relative traveling speed, based on the transferred multi-dimensional aggregation data, so as to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell, the updated preset threshold service time and preset threshold relative traveling speed being transferred to said macro cell base station controller, said macro cell base station, said micro cell base station controller and said micro cell base station,

said communication traffic control system further comprises data load means comprising:

an automatic difference data multi-dimensional aggregation statement generation and execution unit operating such that, when said aggregation process unit receives the user environment data, said automatic difference data multi-dimensional aggregation statement generation and execution unit automatically generates and executes a statement that causes communication to be established between said macro cell base station and said operation and management center via said mobile switching center, causes said aggregation process unit to generate

the compressed difference data, based on the user environment data, and to compute difference multi-dimensional aggregation data by performing a multi-dimensional aggregation process on the compressed difference data thus generated;

a unit for automatic generation and execution of a data load program with an addition instruction operating such that, when the difference multi-dimensional aggregation data is computed, the unit automatically generates a data load program with an addition instruction, creating a statement for loading the difference multi-dimensional aggregation data from said aggregation process unit into said multi-dimensional aggregation data management unit of the operation and management center, and causing said multi-dimensional aggregation data management unit to ensure that a minimum bandwidth is allocated to all the mobile stations in the macro cell by updating the preset threshold service time and the preset threshold relative traveling speed, based on the transferred difference multi-dimensional aggregation data; and

an automatic reverse data load program generation and execution unit operating such that, when the preset threshold service time and the preset threshold relative traveling speed are updated, the automatic reverse data load program generation and execution unit automatically generates a statement for loading the updated preset threshold service time and preset threshold

relative traveling speed from said multi-dimensional aggregation data management unit into said macro cell base station controller and said micro cell base station controller via said mobile switching center,

and wherein communication traffic is controlled based on the updated preset threshold service time and preset threshold relative traveling speed loaded by said data load means.

ABSTRACT

An automatic difference data multi-dimensional aggregation statement generation and execution unit 61 causes an aggregation process unit 14 to generate compressed difference data 102 based on user environment data 101, and to perform a multi-dimensional aggregation process so as to compute difference multi-dimensional aggregation data. A unit 62 for automatic generation and execution of a data load program with an addition instruction causes the aggregation process unit 14 to load the difference multi-dimensional aggregation data 103 into a multi-dimensional aggregation data management unit 43 of an operation and management unit 41, causes the multi-dimensional aggregation management unit 43 to add the loaded difference multi-dimensional aggregation data 103 to multi-dimensional aggregation data 111 in a multi-dimensional database 42 related to communication traffic, and causes a preset threshold service time T and a preset threshold relative traveling speed V to be updated so as to ensure that a minimum bandwidth is allocated to all mobile stations 3 in a macro cell 1. An automatic reverse data load program generation and execution unit 63 loads the updated threshold service time T and preset threshold relative traveling speed V from the multi-dimensional aggregation data management unit 43 into a macro cell base station controller 12 and

all micro cell base station controllers 22.

FIG.1

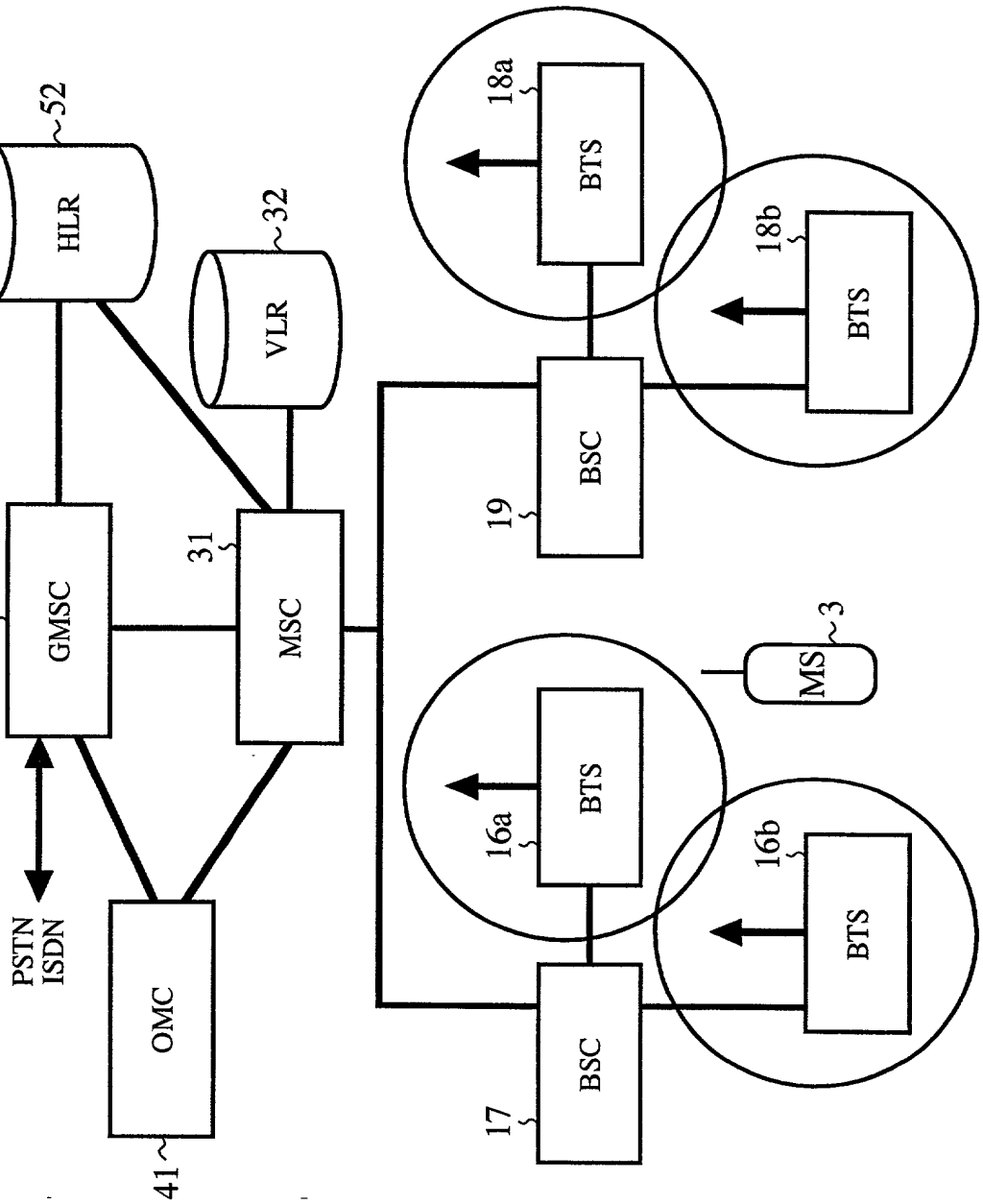
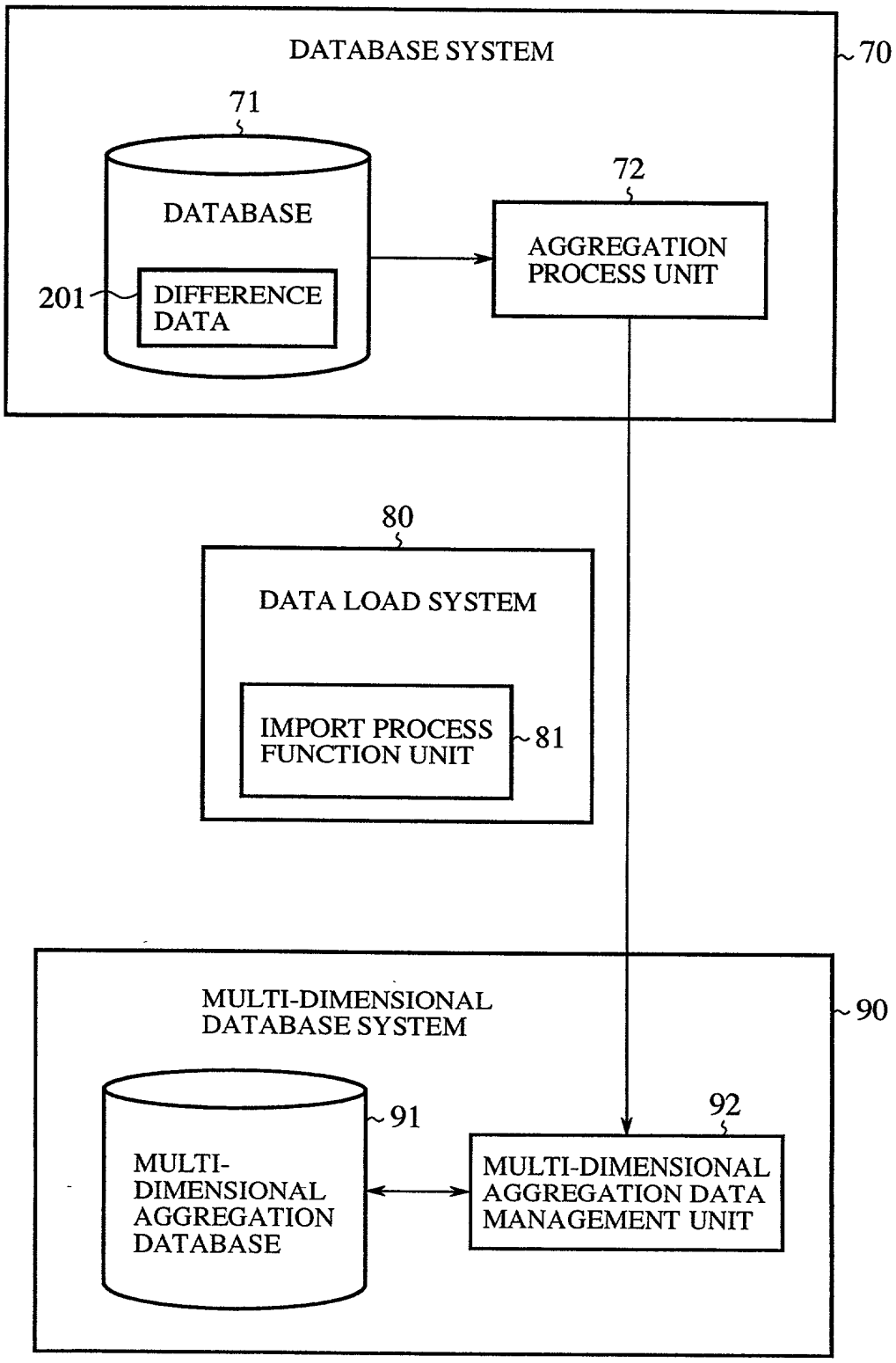


FIG.2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70
71
DATABASE
201
DIFFERENCE DATA
72
AGGREGATION PROCESS UNIT
80
DATA LOAD SYSTEM
IMPORT PROCESS FUNCTION UNIT
81
MULTI-DIMENSIONAL DATABASE SYSTEM
90
91
MULTI-DIMENSIONAL AGGREGATION DATABASE
92
MULTI-DIMENSIONAL AGGREGATION DATA MANAGEMENT UNIT

FIG.3

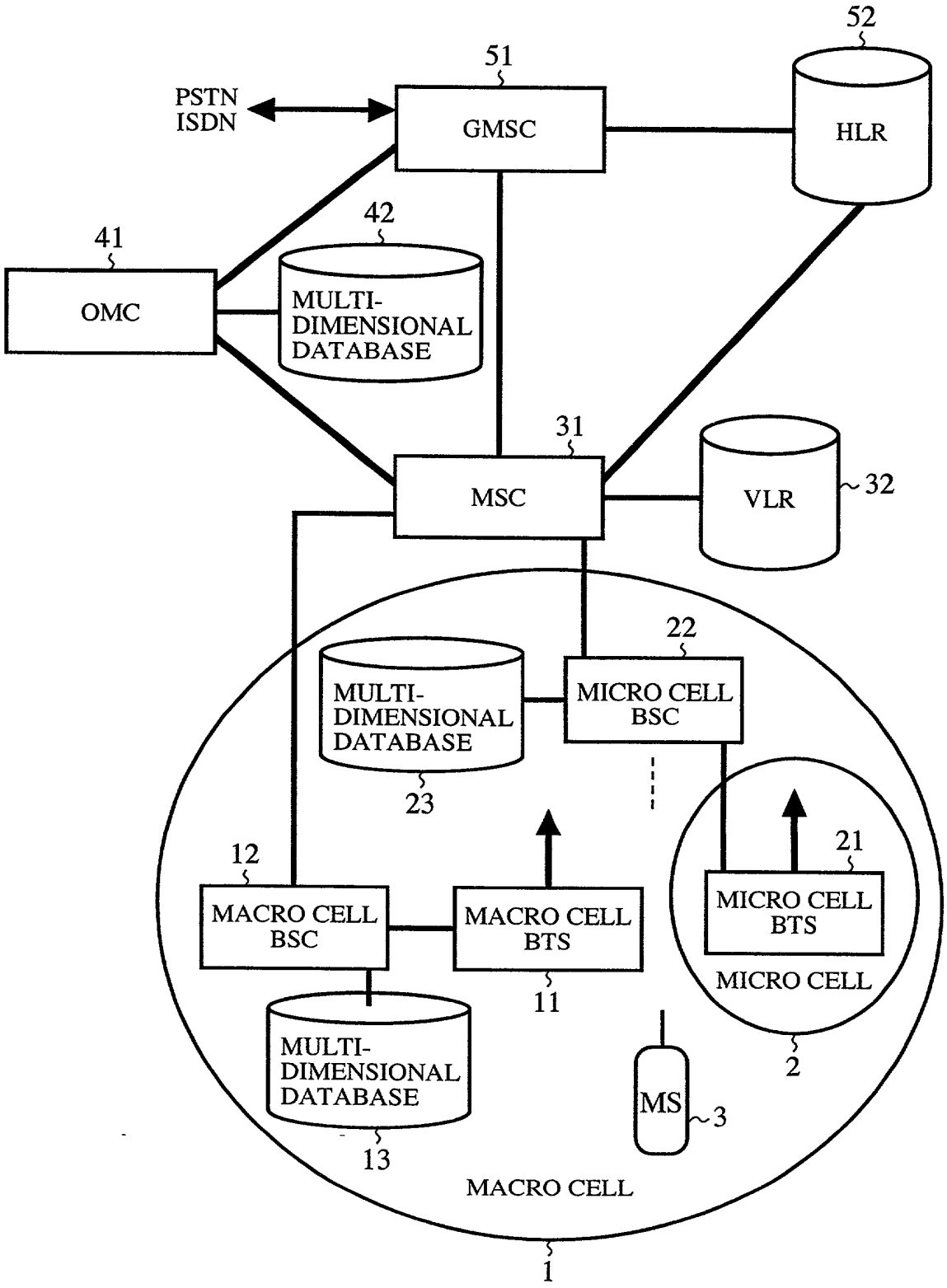

52
51
PSTN
ISDN
GMSC
HLR
42
41
OMC
MULTI-
DIMENSIONAL
DATABASE
31
MSC
VLR
32
22
MULTI-
DIMENSIONAL
DATABASE
MICRO CELL
BSC
23
12
21
MACRO CELL
BSC
MACRO CELL
BTS
MICRO CELL
BTS
MICRO CELL
11
MULTI-
DIMENSIONAL
DATABASE
MS
3
2
13
MACRO CELL
1

FIG.4

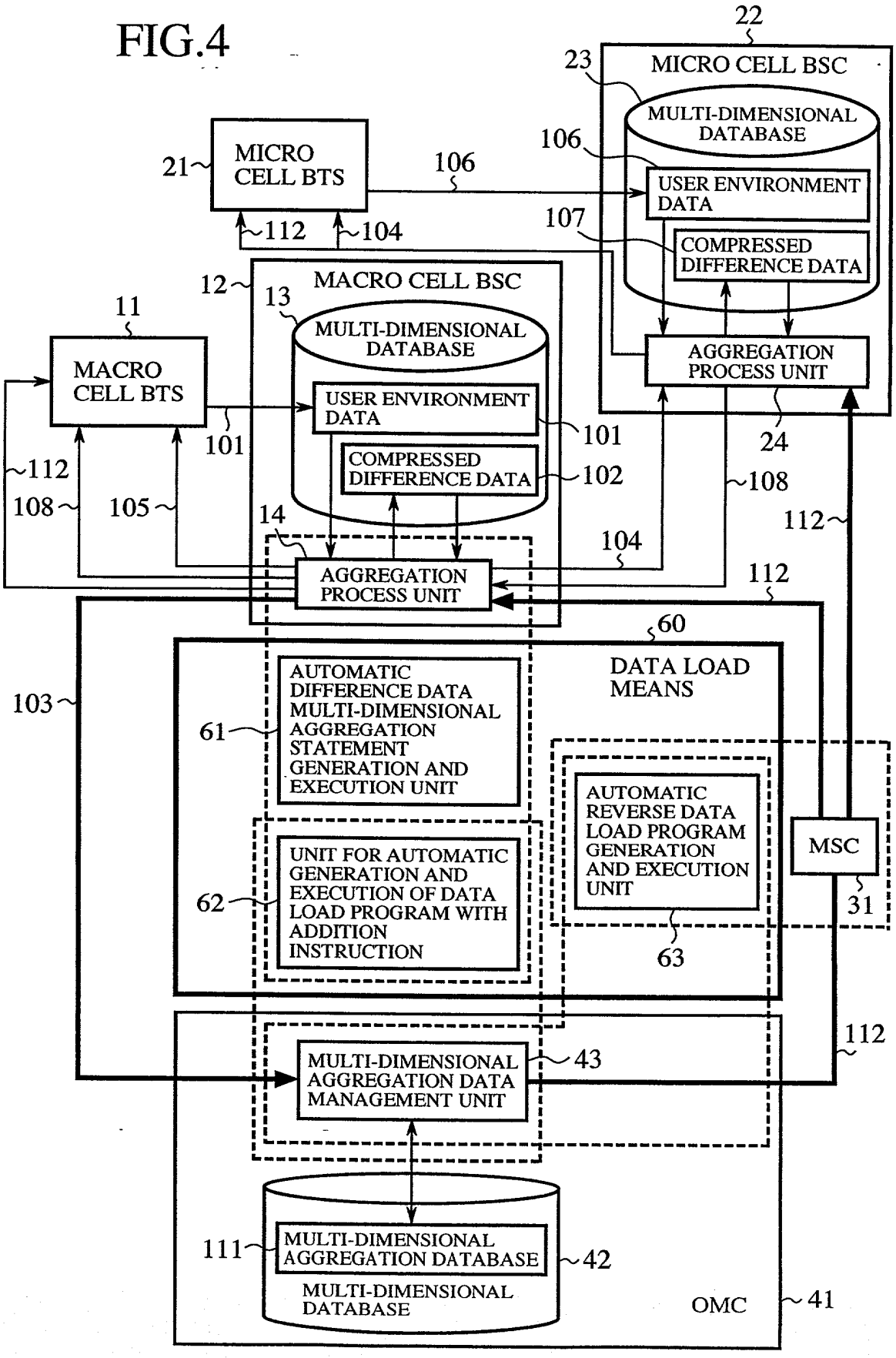

22
MICRO CELL BSC
23
MULTI-DIMENSIONAL DATABASE
106
USER ENVIRONMENT DATA
107
COMPRESSED DIFFERENCE DATA
AGGREGATION PROCESS UNIT
24
21
MICRO CELL BTS
106
112
104
12
MACRO CELL BSC
13
MULTI-DIMENSIONAL DATABASE
11
MACRO CELL BTS
USER ENVIRONMENT DATA
101
101
COMPRESSED DIFFERENCE DATA
102
112
108
105
108
14
104
112
AGGREGATION PROCESS UNIT
112
60
DATA LOAD MEANS
103
AUTOMATIC DIFFERENCE DATA MULTI-DIMENSIONAL AGGREGATION STATEMENT GENERATION AND EXECUTION UNIT
61
AUTOMATIC REVERSE DATA LOAD PROGRAM GENERATION AND EXECUTION UNIT
MSC
31
UNIT FOR AUTOMATIC GENERATION AND EXECUTION OF DATA LOAD PROGRAM WITH ADDITION INSTRUCTION
62
63
112
MULTI-DIMENSIONAL AGGREGATION DATA MANAGEMENT UNIT
43
111
MULTI-DIMENSIONAL AGGREGATION DATABASE
42
MULTI-DIMENSIONAL DATABASE
OMC
41

FIG.5

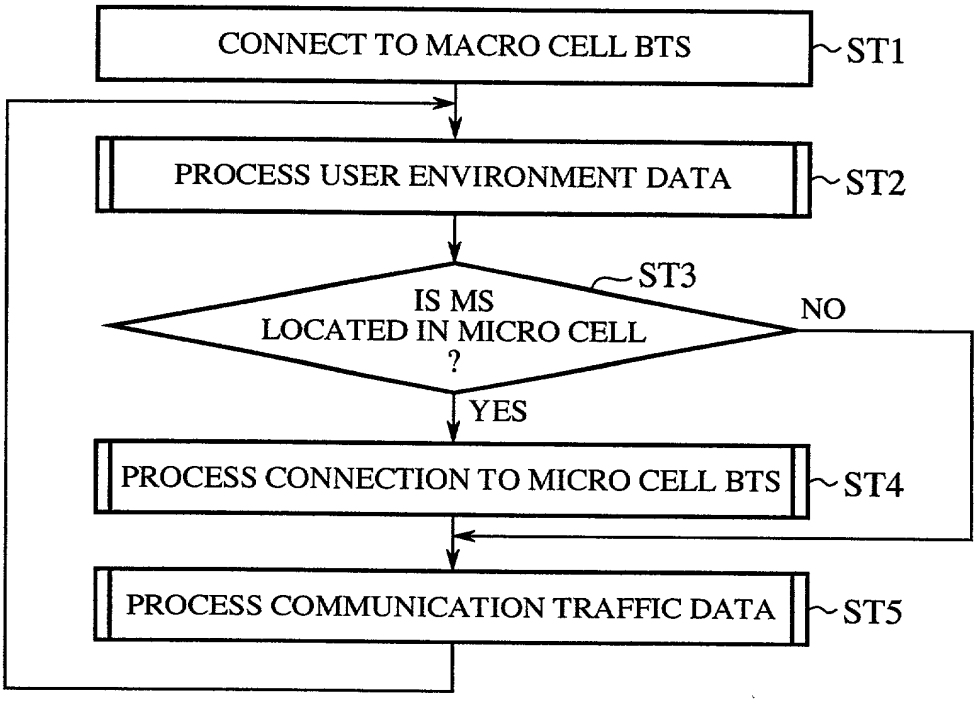

CONNECT TO MACRO CELL BTS
ST1
PROCESS USER ENVIRONMENT DATA
ST2
IS MS LOCATED IN MICRO CELL ?
ST3
NO
YES
PROCESS CONNECTION TO MICRO CELL BTS
ST4
PROCESS COMMUNICATION TRAFFIC DATA
ST5

FIG.6

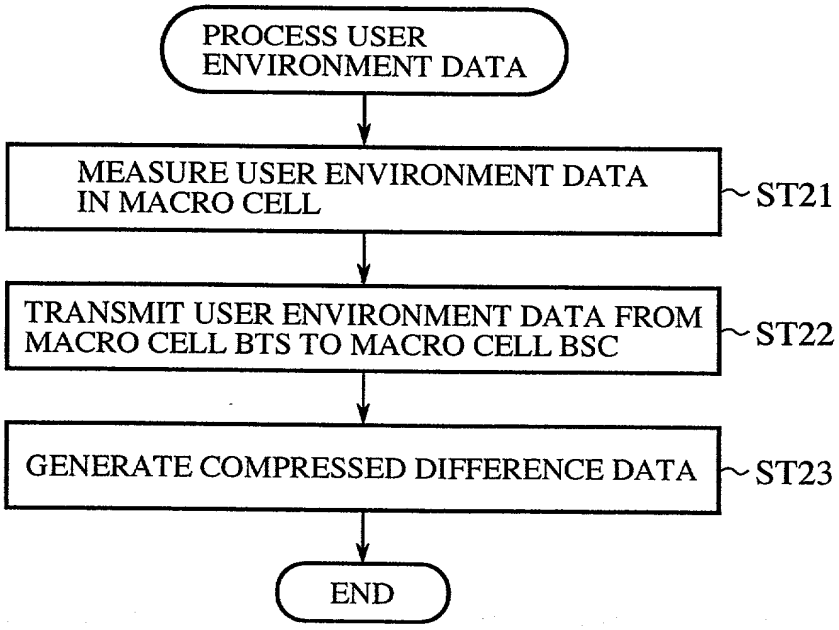

PROCESS USER ENVIRONMENT DATA
MEASURE USER ENVIRONMENT DATA IN MACRO CELL
ST21
TRANSMIT USER ENVIRONMENT DATA FROM MACRO CELL BTS TO MACRO CELL BSC
ST22
GENERATE COMPRESSED DIFFERENCE DATA
ST23
END

FIG.7

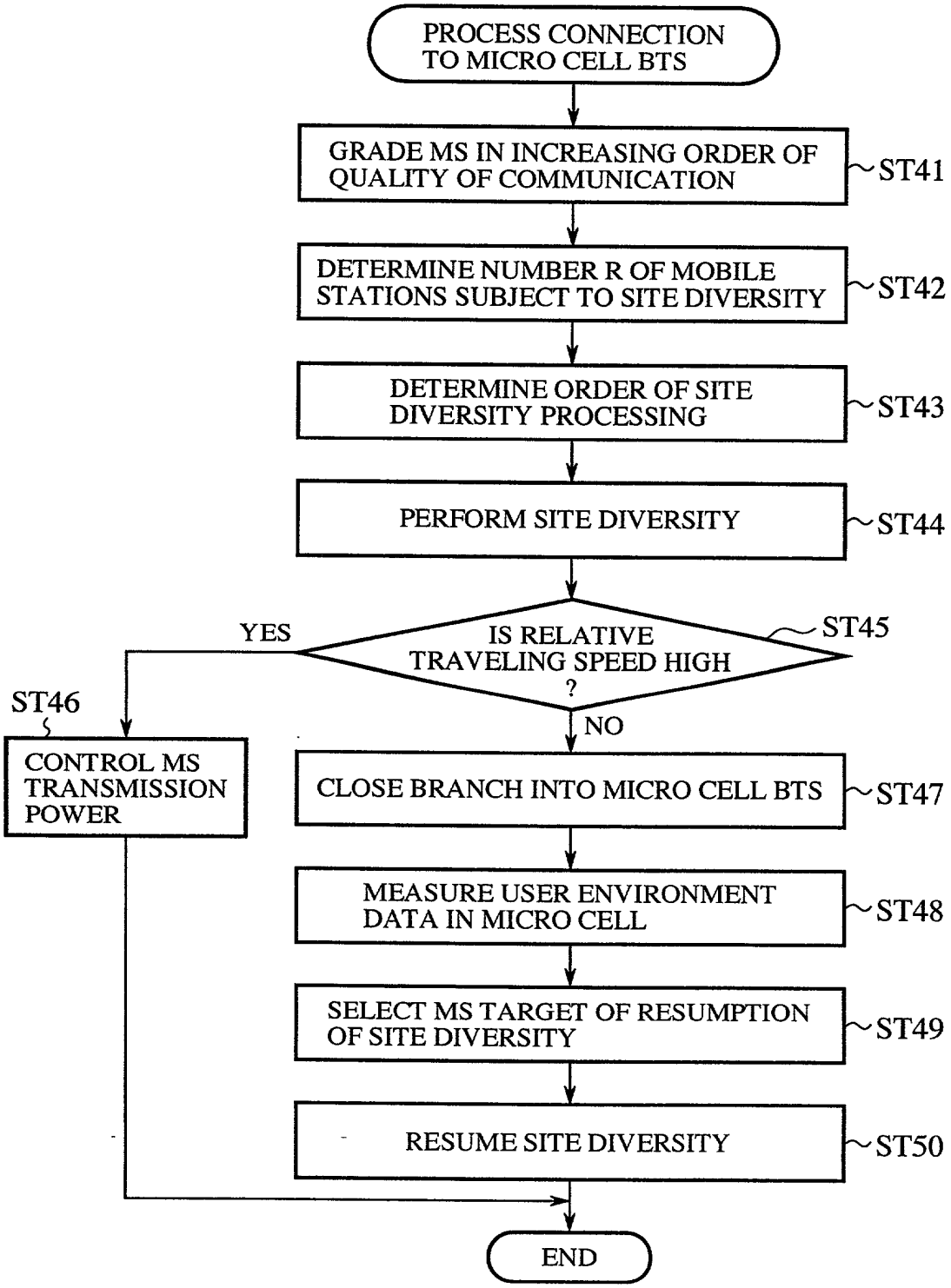

PROCESS CONNECTION TO MICRO CELL BTS
GRADE MS IN INCREASING ORDER OF QUALITY OF COMMUNICATION
ST41
DETERMINE NUMBER R OF MOBILE STATIONS SUBJECT TO SITE DIVERSITY
ST42
DETERMINE ORDER OF SITE DIVERSITY PROCESSING
ST43
PERFORM SITE DIVERSITY
ST44
IS RELATIVE TRAVELING SPEED HIGH ?
ST45
YES
NO
ST46
CONTROL MS TRANSMISSION POWER
CLOSE BRANCH INTO MICRO CELL BTS
ST47
MEASURE USER ENVIRONMENT DATA IN MICRO CELL
ST48
SELECT MS TARGET OF RESUMPTION OF SITE DIVERSITY
ST49
RESUME SITE DIVERSITY
ST50
END

FIG.8

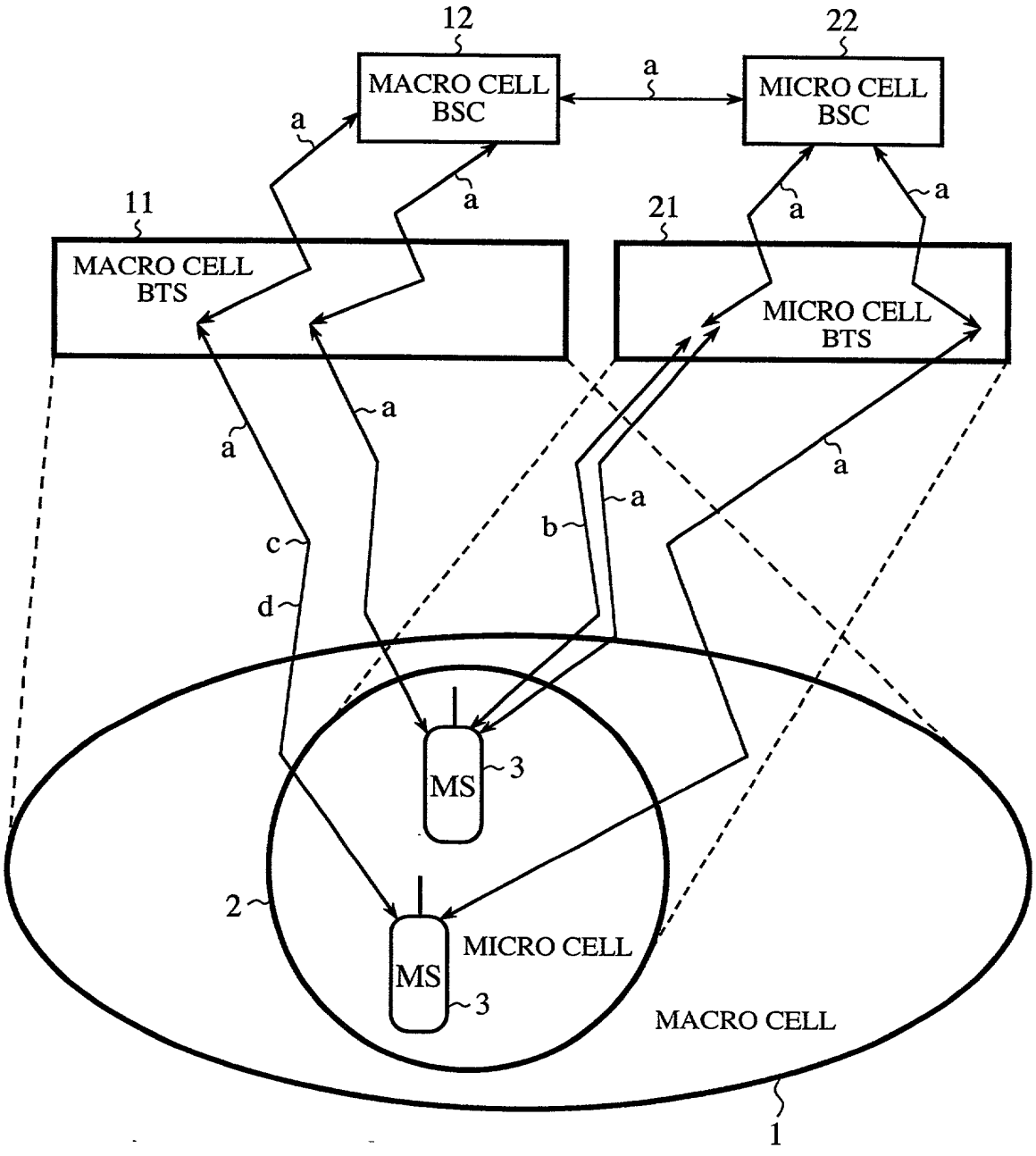
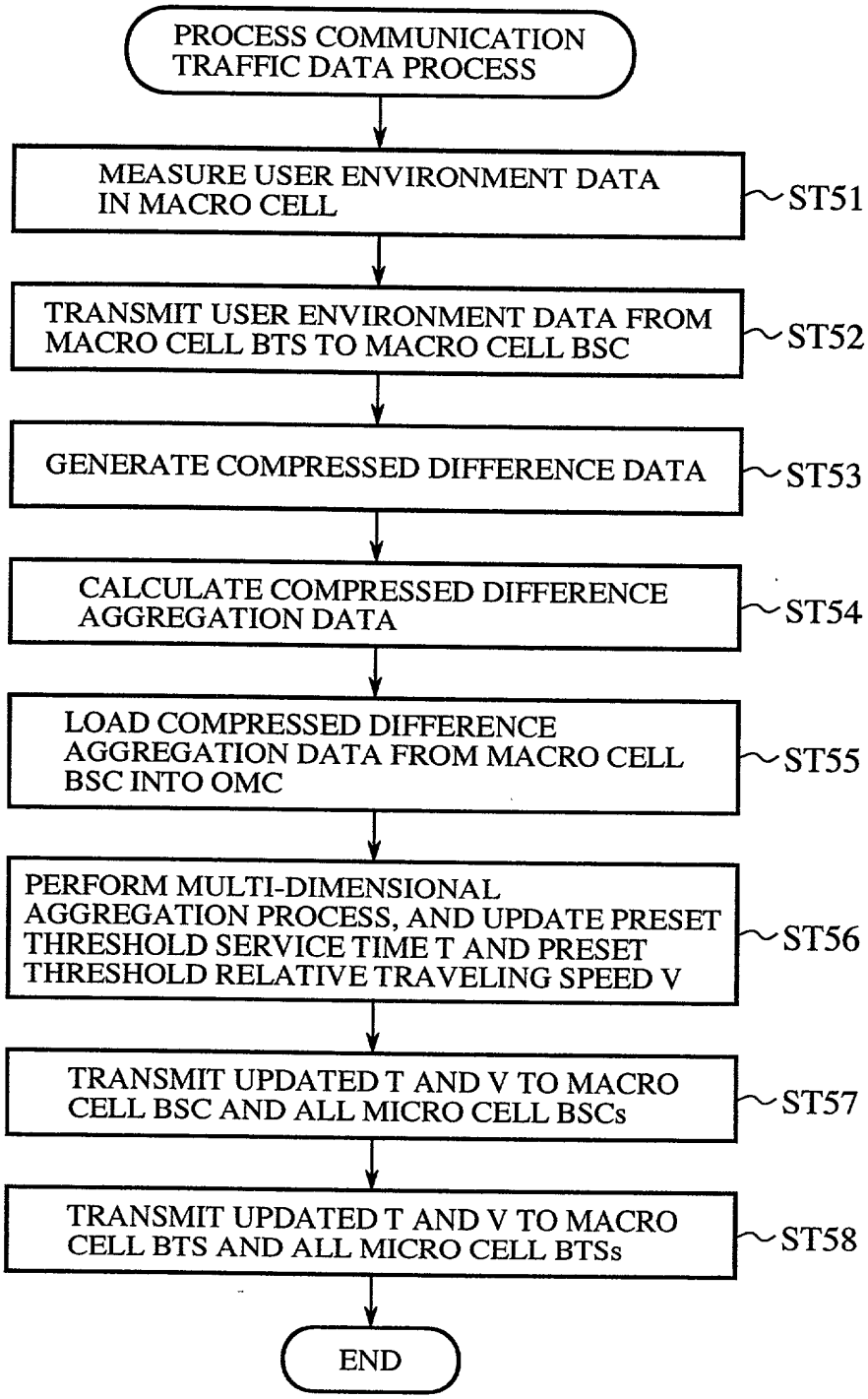

12
MACRO CELL BSC
22
MICRO CELL BSC
a
11
MACRO CELL BTS
21
MICRO CELL BTS
b
c
d
MS
3
2
MICRO CELL
MACRO CELL
1

FIG.9


PROCESS COMMUNICATION TRAFFIC DATA PROCESS
MEASURE USER ENVIRONMENT DATA IN MACRO CELL
ST51
TRANSMIT USER ENVIRONMENT DATA FROM MACRO CELL BTS TO MACRO CELL BSC
ST52
GENERATE COMPRESSED DIFFERENCE DATA
ST53
CALCULATE COMPRESSED DIFFERENCE AGGREGATION DATA
ST54
LOAD COMPRESSED DIFFERENCE AGGREGATION DATA FROM MACRO CELL BSC INTO OMC
ST55
PERFORM MULTI-DIMENSIONAL AGGREGATION PROCESS, AND UPDATE PRESET THRESHOLD SERVICE TIME T AND PRESET THRESHOLD RELATIVE TRAVELING SPEED V
ST56
TRANSMIT UPDATED T AND V TO MACRO CELL BSC AND ALL MICRO CELL BSCs
ST57
TRANSMIT UPDATED T AND V TO MACRO CELL BTS AND ALL MICRO CELL BTSs
ST58
END

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者（下記の名称が複数の場合）であると信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled.

"TRAFFIC CONTROL SYSTEM FOR MOBILE COMMUNICATIONS SYSTEM"

上記発明の明細書は、

- ☐ 本書に添付されています。
- ☒ ___月___日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、（該当する場合）_____に訂正されました。

the specification of which

- ☐ is attached hereto.
- ☒ was filed on July 31, 2000 as United States Application Number or PCT International Application Number PCT/JP00/05152 and was amended on _____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第35編119条（a）-（d）項又は365条（b）項に基づき下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約365（a）項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張 Yes はい	No いいえ
			☐	☐
			☐	☐

私は、第35編米国法典119条（e）項に基づいて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第35編120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約365条（c）に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第35編112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第37編1条56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自信の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第18編第1001条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状：私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。
(弁護士、または代理人の指名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

022850

書類送付先

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国籍	Citizenship
郵便の宛先	Post Office Address

(第三以降の共同発明者についても同様に記載し、署名すること)

(Supply similar information and signature for third and subsequent joint inventors.)